ULTRAPROBE 3000

INSTRUCTION MANUAL

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WELCOME TO THE WONDERFUL WORLD OF AIRBORNE ULTRASOUND INSPECTION

Congratulations, your digital Ultraprobe 3000 is full of highly advanced technical features that will provide you with the ability to locate leaks, detect faulty steam traps, test bearings, store and download your test data.

1. OVERVIEW

Your Ultraprobe 3000 is a versatile instrument with many features that will make your inspections easy, fast and accurate. As with any new instrument, it is important to review this manual before you begin inspections.

While simple to use as a basic inspection tool, there are many powerful features that when understood, will open up a world of opportunities for inspection and data analysis.

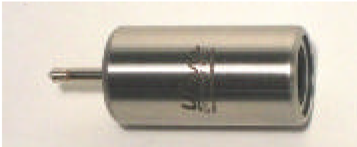
ULTRASOUND TECHNOLOGY INSTRUCTION SCHOLARSHIP CERTIFICATE:
Your Ultraprobe 3000 has many applications ranging from leak detection to mechanical inspection and may be used to trend, analyze or just find a problem. How it is used is up to you. As you gain knowledge and learn how many modes of inspection you can cover, you might want to extend your knowledge by enrolling in one of the many training courses offered by UE Training Systems, Inc. A Scholarship certificate is available to you. Simply fill out the form found at the end of this manual and mail or fax it in.

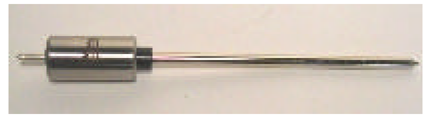
The Ultraprobe 3000 is an ultrasonic inspection information, storage and retrieval system in a pistol-grip housing. There are two modes that are important to understand:

OPERATION MODE:
The operation mode will be described in detail under the operation mode section. In this mode you will perform all inspection actions such as scanning, probing, "Click and Spin" activities, and store data. NOTE: "**Click**" operations require ***pressing*** a dial. "**Spin**" operations require ***turning*** a dial.

SET UP MODE:
The setup mode will be described in detail under the Set Up Mode section,. There are seven menu options that will be described in that section.

2. BASIC COMPONENTS





Scanning Module

Stethoscope Module

A. PLUG-IN MODULES

SCANNING MODULE:

This module is utilized to receive air-borne ultrasound such as the ultrasounds emitted by pressure/vacuum leaks and electrical discharges. There one male plug at the rear of the module. For placement, align the plug with the corresponding receptacle in the front end of the pistol housing and plug in. The Scanning Module has a piezoelectric transducer to pick up the airborne ultrasound.

STETHOSCOPE (CONTACT) MODULE:

This is the module with the metal rod. This rod is utilized as a "waveguide" in that it is sensitive to ultrasound that is generated internally such as within a pipe, bearing housing or steam trap. Once stimulated by ultrasound, it transfers the signal to a piezoelectric transducer located in the module housing directly behind the “wave guide”. For placement align the plug with the corresponding receptacle in the front end of the pistol housing and plug in.

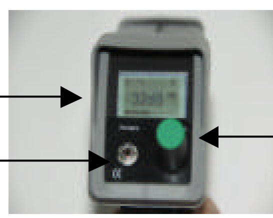
B. PISTOL-GRIP HOUSING

DISPLAY PANEL:

In the Operation Mode the Display Panel will show intensity levels (as dB and as a bar graph), Sensitivity Level, Storage location number, and Battery Level,. Intensity levels are shown simultaneously as a numeric dB value and on a sixteen-segmented bar graph (with each segment representing 3 dB). This Ultraprobe receives ultrasound centered around 40 kHz and is non-adjustable.

Display Panel

Headphone Jack



Sensitivity Control/ Storage Entry Dial

TRIGGER ON/OFF TRIGGER SWITCH:

The Ultraprobe is always "off' until the trigger switch is pressed. To operate, pull in and hold the trigger. To turn the instrument off, release the trigger.

USB PORT:

This port is used to download/transfer information from the Ultraprobe 3000 into the computer. It is also used to charge the instrument. Before downloading data be sure the cable is connected to both the USB port and to the computer. When charging, plug the recharger cable into the USB and then into the electric receptacle.

BATTERY COMPARTMENT:

The Handle contains the rechargeable battery**. Remove the battery only when it cannot hold a charge and needs to be replaced.** If the battery is to be changed, remove the cover and replace.

BATTERY:

The battery is a rechargeable battery and is charged using the USB port. **WARNING:** ONLY USE UE SYSTEMS BATTERY RECHARGER #BCH-3L. **DO NOT USE UNAUTHORIZED BATTERIES OR BATTERY RECHARGERS! Doing so may be hazardous and may damage the instrument and will void the warranty.** Recharging the battery takes about 1 hour; continuous run time is about 2 hours. With normal operation (on-off between tests) the charge will last 4-6 hours. On the BCH-3L BATTERY RECHARGER, when the light is red the battery is charging and when it is green it is fully charged.

WRIST STRAP:
To protect the instrument, against unexpected droppage use the wrist strap.

SENSITIVITY/STORAGE ENTRY CONTROL DIAL:
This is the most important control in the unit. It is used to adjust the sensitivity. When clicked it changes functions such as store data or change the storage location number. It is also used to get into the “SET UP” mode (described later).

HEADPHONES JACK:
This is where you plug in the headphones. Be sure to plug it in firmly until it clicks.

3. ACCESSORIES

A. STANDARD ACCESSORIES

DHC-2HH:
Headphone headset is for use with a hard hat. This heavy-duty headset is designed to block out intense sounds often found in industrial environments so that the user may easily hear the sounds received by the ULTRAPROBE. In fact, the headphones provide over 23 dB of noise attenuation.

WTG-1 WARBLE TONE GENERATOR:
The WTG-1 Tone Generator is an ultrasonic transmitter designed to flood an area with ultrasound. It is used for a special type of leak test. 'When placed inside an empty container or on one side of a test item, it will flood that area with an intense ultrasound that will not penetrate any solid but will flow through any existing fault or void. By scanning with the Scanning Module, empty containers such as pipes, tanks, windows, doors, bulkheads or hatches can be instantly checked for leakage. This Tone Generator is a WARBLE TONE GENERATOR. This internationally patented transmitter sweeps through a number of ultrasonic frequencies in a fraction of a second to produce a strong, recognizable "Warble" signal. The warble tone prevents a standing wave condition, which can produce false readings and provides for a consistency of testing in practically any material.

RUBBER FOCUSING PROBE:
The Rubber Focusing Probe is a cone-shaped rubber shield.
It is used to block out stray ultrasound and to assist in focusing on the field of reception of the Scanning Module.

STETHOSCOPE EXTENSION KIT:
This consists of three metal rods that will enable a user to reach up to 31 additional inches (78.7 cm) with the Stethoscope Probe.

B. OPTIONAL ACCESSORIES

LONG RANGE MODULE LRM-3:
This uniquely designed module doubles the detection distance of a standard scanning module and provides a narrow (10^o) sensing area making it ideally suited for locating ultrasonic emissions (such as a leak or electrical emission) at a distance.

RAS-MT:
A magnetically mounted transducer and cable magnetically attaches to metal surfaces such as valves, steam traps and bearings. The RAS-MT needs a RAM (Remote Access Module) to connect to the Ultraprobe 3000. (See RAS-MT, page 11)

HEADSET DHC-1:
These headphones fit over the head and are not used with a hard hat. This heavy-duty headset is designed to block out intense sounds often found in industrial environments so that the user may easily hear the sounds received by the ULTRAPROBE. In fact, the standard headphones provide over 23 dB of noise attenuation.

DHC 1991 EAR PIECE:
Ear piece eliminates the need for standard headphones.

SA-2000 SPEAKER AMPLIFIER:
The SA-2000 is a loud speaker and amplifier that is compatible with the Ultraprobe headphone output jack.

UFMTG-1991:
The UFMTG 1991 is a multi directional warble tone generator. It has a high power output with a circular transmission pattern of 360?.

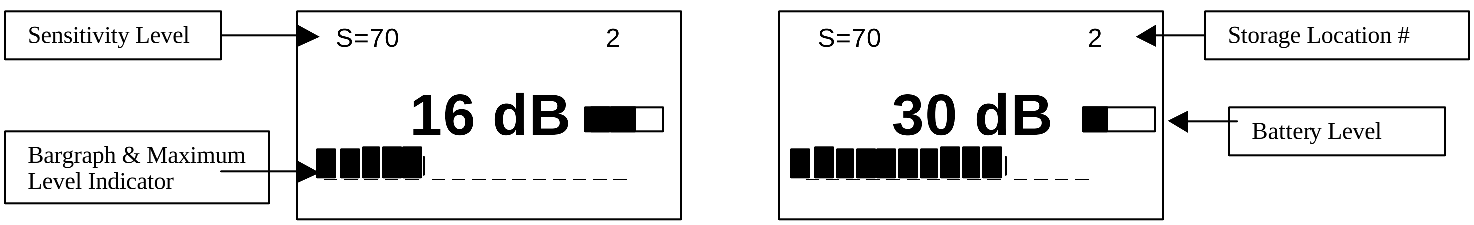
WTG-2SP WARBLE PIPE THREADED TONE GENERATOR:
A Warble Tone Generator that is used in test conditions where it is not possible to physically place the standard WTG-1 Warble Tone Generator, such as in pipes or in certain heat exchangers or tanks. Features: 1” NPT male threaded nipple with adapters for ¾” and ½” female nipple with a 10 turn amplitude adjustment dial. Metric adapters available.

LLA:
Liquid Leak Amplifier is a special bubble solution that is used to detect extremely small leaks (ranging from 1 x 10-3 to 1 x 10-6std.cc/sec.) LLA produces small bubbles that form and then collapse and produce strong ultrasonic signals. They collapse instantly so there is little or no waiting time.

4. OPERATION MODE

DISPLAY PANEL:
When the trigger is pressed to turn the instrument on, the Display Panel will display the decibel and bargraph intensity levels. The sensitivity level will be displayed in the upper left corner. The storage location number will be shown in the upper right corner. The Battery Charge level is shown in the mid-right side of the display.

BAR GRAPH DISPLAY:
The bar graph has 16 segments. Each segment represents 3 decibels. At the end of the bar graph is a vertical line, which indicates the maximum intensity. This is a maximum level hold function. When in operation, the bar graph will move up and down the scale as an indication of the amplitude of a sensed ultrasound. The maximum level indicator will remain at the highest sensed intensity during a particular inspection until: 1. A new maximum reading is detected, or 2. The trigger is released and the instrument is turned off. At which time it will reset.



SENSITIVITY CONTROL/STORAGE ENTRY DIAL:

TO ADJUST THE SENSITIVITY:

- Look at the display and note the “S=” value. If the instrument is within range, a dB (decibel) value will be displayed.
- The maximum sensitivity value is 70; the minimum is 0.
- To reduce the sensitivity/volume, rotate the dial ***counter clockwise***. To increase the sensitivity, rotate the dial ***clockwise***. The Sensitivity control dial increases/decreases the sensitivity of the instrument simultaneously with the sound level in the headphones

NOTE: the instrument needs to be in range for accurate testing.

- ***If the sensitivity is too low***, a blinking arrow pointing to the right will appear and there will be no numeric decibel visible in the display panel. If this occurs, increase the sensitivity until the arrow disappears (in low level sound environments the arrow will blink continuously and It will not be possible to achieve a dB indication until a higher intensity level is sensed).

- ***If the sensitivity is too high***, a blinking arrow pointing to the left will appear and there will be no numeric decibel visible on the display panel. Reduce the sensitivity until the arrow disappears and the numeric decibel value is shown.

NOTE: The blinking arrow indicates the direction in which the Sensitivity Control Dial is to be turned when out of range..

- The Sensitivity Control Dial controls the bar graph display.

FREQUENCY:
- This instrument is set to the peak frequency response of the transducers which is 40 kHz. It is non-adjustable.

TO STORE A READING:
There are 2 types of storage modes: **Normal** and **Quick**.
For **"Normal" Storage**
- Firmly "Click"(press in) the Sensitivity Dial. The Storage location will blink and the phrase SPIN/CLICK will appear on the bottom of the display panel.
- If you wish to use a storage location other than the one shown, "spin" the Sensitivity dial up (clockwise) or down (counter clockwise) to the desired location.
- If the Storage Location is the one you chose to use, click the Sensitivity Dial again and you will see a prompt on the bottom of the display panel: **STORE? YES** . If you want to store the data, "click" the Sensitivity Dial once more and the record is stored at the set location. The Storage Location number will automatically move up to the next sequential number.

- If you chose not to store the record, "spin" the Sensitivity Dial and you will see the word **NO**, "click" the Sensitivity Dial and you will return to the operation mode.

- For **Quick Store** (see Set Up Mode, "**Menu 05; Store Mode**")

- When in the Quick Store mode, "click (press in) the Sensitivity Dial once and the record is stored. The Storage Location number will automatically move up to the next sequential number.

TO OVERWRITE DATA OR TO ENTER DATA IN A NEW LOCATION:
- Click (press in) the Sensitivity dial button; the Storage Location number will blink.
- Spin the Sensitivity Dial until the desired storage location is displayed on the screen
- Click the Sensitivity Dial again and the prompt **STORE YES**? Will appear.
- To store the new information in that location, "click" the Sensitivity Dial again and the record will be over written.

TO DOWNLOAD THE INFORMATION:
- Refer to Setup Mode, 01 ***Send Records***

5. SETUP MODE

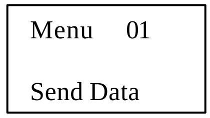
To enter the Set Up Mode:
1. Make sure the Ultraprobe is off.
2. Click (Press) the Sensitivity dial and hold it in. while you pull/squeeze the trigger. Hold both the Sensitivity Dial and Trigger in until the screen displays: **" Menu 01; Send Records"**. NOTE: Hold the Trigger in during any of the Set Up Mode operations or the instrument will turn off.
3. Once Menu 01 is displayed, you may move to any of the other Menu Modes by spinning the Sensitivity Dial up or down (clockwise or counter clockwise).
4. When the desired Menu Mode is reached, click (push) the Sensitivity Control in to enter/use that menu function.
5. You may spin to enter and exit any Menu mode in the Set Up mode as long as the trigger is squeezed to keep the instrument on.

01 Send Records

NOTE: Before downloading data, be sure the Ultraprobe is connected to the computer via the USB cable.

To send data from the Ultraprobe to your computer:
1. Make sure the Ultraprobe is off.

2. Click (Press) the Sensitivity dial and hold it in. while you pull/squeeze the trigger. Hold both the Sensitivity Dial and Trigger in until the screen displays: **" Menu 01; Send Records"**. NOTE: Hold the Trigger in during any of the Set Up Mode operations or the instrument will turn off.
3. When Menu 01, **Send Data** is shown, "click" the Sensitivity Control Dial and all the data will be transferred to the computer. (NOTE: For software management, refer to Ultratrend DMS^{Tm} Instructions.)



02 Delete Records

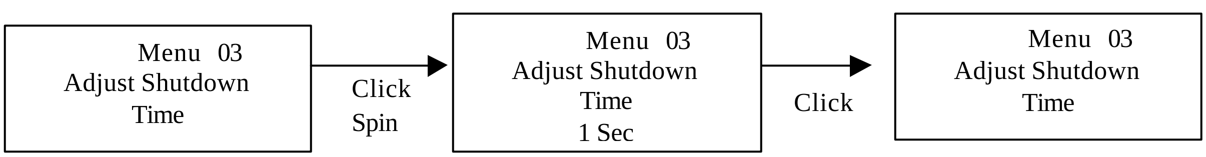
To clear all records in preparation for your next route, you need to Delete Records.

1. Enter Setup Mode…be sure to continue to hold the Trigger in.
2. Spin clockwise to Menu 02, **Delete Records**
3. You will see a prompt: Delete Records Confirm?
4. To exit, select NO
5. To Delete, spin the Sensitivity Dial to YES and "click"(press) the Sensitivity dial

03 Adjust Shutdown Time

The shutdown time allows you to select the time it will take to turn the instrument off once the trigger is released. You may select from 1, 5, 30, 60, and 300 seconds.

1. Enter Setup Mode…be sure to continue to hold the Trigger in.
2. Spin to Menu 03 **Adjust Shutdown Time**
3. "Click" (press) the Sensitivity Dial in to enter
4. The Spin to the desired turn off time
5. Click to exit

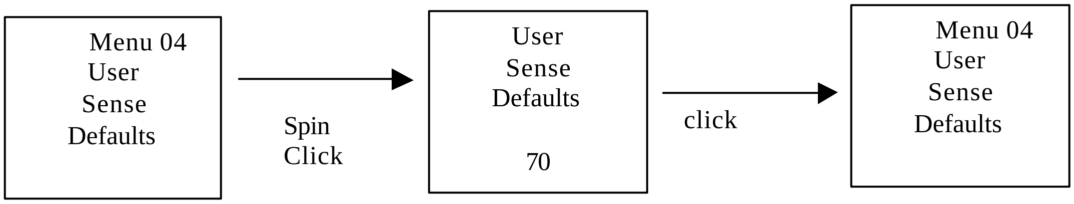


04 User Sense (Sensitivity) Defaults

With experience a user will know which sensitivity level to use as the highest level. This mode allows the user to adjust the default starting sensitivity level for inspection routes.

To set the Sensitivity Default:

1. Enter Setup Mode…be sure to continue to hold the Trigger in.
2. Spin to Menu 04 **User Sense Defaults**
3. "Click" the Sensitivity Dial to Enter
4. Spin to the desired level (70 to 00, 70 is highest 00 is the lowest)
5. "Click" to set



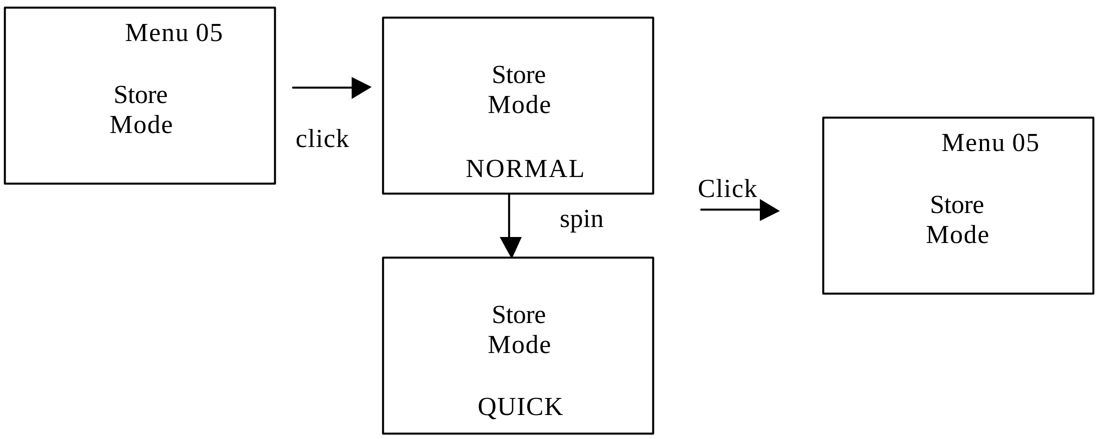
05 Store Mode

There are two store mode selections: **Normal** and **Quick**.

In the **Normal** store mode the store procedure includes three "Clicks" of the Sensitivity dial. 1. The first click enters the Storage Mode where the user can spin to a different record location or stay in the current location. 2 The second click allows the user to accept or decline the Store operation. 3. The third click exits the Store Mode to the Main Screen. The **Quick** mode requires one "click" to store the data. Every time you store data, the instrument will move up one record to the next storage location.

To select Store Mode:

1. Enter Setup Mode…be sure to continue to hold the Trigger in.
2. Spin to Menu 05 **Store Mode**
3. "Click" the Sensitivity Dial to Enter
4. A prompt will blink **NORMAL** or **QUICK**
5. To change, "spin" the Sensitivity Dial
6. To select either Normal or Quick, when the desired mode is blinking, "click" the Sensitivity Dial



06 Program Update

Whenever the operating system software is changed, the program can be downloaded off the UE Systems web site: www.uesystems.com. Upon receiving notice, Download the program to your computer and follow the procedure supplied by UE Systems.

Caution: Failure to follow the "Program Update" procedure may prevent the UP3000 from programming properly and result in the instrument being shipped back to UE Systems for repair.

07 Exit (to operation mode)

Click the Sensitivity Control dial and you will exit to Operation Mode.

6. USERS INSTRUCTIONS

STORING DATA

Storing data can be performed with either the **Normal** or **Quick** store modes. (see Setup **Menu 05 Store Data**) To Store Data in the NORMAL STORE MODE:

1. "Click" the Sensitivity Dial to Enter storage mode
2. The Display Screen will show: Storage Location #, Current dB level and a prompt: STORE/CLICK
3. The Storage Location will blink. You can use this current location or change it. To change the location "Spin" the Sensitivity Dial to the desired location.
4. "Click" the Sensitivity Dial and the Storage Location will stop blinking. You will see a prompt: STORE? YES
5. To store, "click" the Sensitivity Dial and the data will be stored.
6. If you do not wish to store the data, "spin" the Sensitivity Dial to NO and "click" to exit.

SCANNING MODULE:

- Plug in to front end.
- Align the plug located at the rear of the module with the receptacle in the front end of the Pistol Housing and plug in.
- Start to scan the test area.

METHOD OF AIRBORNE DETECTION:

The method of air borne detection is to go from the "gross to the fine". Start off at a high sensitivity level and if there is too much ultrasound in the area, reduce the sensitivity, following the sound to the loudest point. If necessary, place the RUBBER FOCUSING PROBE (described below) over the scanning module and proceed to follow the test sound to its' loudest point constantly reducing the sensitivity while following the bargraph indicator on the display.

HEADPHONES:

To use, firmly plug the headphone jack into the "Phones" receptacle on the pistol housing, and place the headphones over your ears.

RUBBER FOCUSING PROBE:

The Rubber Focusing probe fills two functions: it deflects stray ultrasounds and enhances the reception of weak airborne signals. To use, simply slip it over the front of the scanning module or the contact module. NOTE: To prevent damage to the module plug, always remove the module BEFORE attaching and/or removing the Rubber focusing Probe.

STETHOSCOPE MODULE:

- The metal rod acts as a wave-guide, directing structure borne ultrasounds directly to the receiving transducer with little impedance.
- Align the plug located at the rear of the module with the receptacle in the front end of the Pistol Housing and plug in.
- Touch test area.

As with the scanning module, go from the "gross" to the "fine". Start a maximum sensitivity on the Sensitivity Dial and proceed to reduce the sensitivity until a satisfactory sound level is achieved.

STETHOSCOPE EXTENSION KIT:

1. Remove the Stethoscope Module from the Metered Pistol Housing.
2. Unscrew the metal rod in the Stethoscope Module.
3. Look at the thread of the rod you just unscrewed and locate a rod in the kit that has the same size thread - this is the "base piece".
4. Screw the Base Piece into the Stethoscope Module.
5. If all 31" (78.7 cm) are to be utilized, locate the middle piece. (This is the rod with a female fitting at one end) and screw this piece into the base piece.
6. Screw third "end piece" into middle piece.
7. If a shorter length is desired, omit step 5 and screw "end piece" into "base piece".

LONG RANGE MODULE:

- Plug in to front end.
- Align the plug located at the rear of the module with the receptacle in the front end of the Pistol Housing and plug in.
- Start to scan the test area.

RAS-MT:

The magnetically mounted transducer acts as a wave guide. The cable attaches to the RAM (Remote Access Module) which is plugged into the pistol grip housing.

- Make sure RAS-MT cable is attached to the RAM
- Plug RAM into the front end.
- Place the magnet transducer on the test point.

TO CHARGE THE UP3000:

- The recharger has a 5-pin mini USB plug that connects to the 5-pin mini USB jack on the Ultraprobe.
- Plug the recharger into an electric outlet and then place the 5-pin mini USB plug into the 5-pin mini USB jack on Ultraprobe 3000.
- The LED on the charger will be red when charging and then turn green when fully charged. Charging will take about one hour. Remove the charger from the electric outlet when fully charged
- **WARNING**: Use the supplied UE Systems recharger ***only***. Use of unauthorized rechargers will void the warranty and may damage the battery and or instrument.

WARBLE TONE GENERATOR (UE-WTG-1):

- Turn Tone Generator on by selecting either "LOW" for a low amplitude signal (usually recommended for small containers) or "HIGH" for high amplitude. In high, the Warble Tone Generator will cover up to 4,000 cubic feet (121.9 cu. meters) of unobstructed space.

- When the Tone Generator is on, a red light (located below the recharge jack in the front) flickers.

- Place the Warble Tone Generator within the test item/container and seal or close it. Then scan the suspect areas with the Scanning Module in the Ultraprobe and listen for where the "warble" ultrasound penetrates.
  As an example, if the item to be tested is the seal around a window place the Warble Tone Generator on one side of the window, close it and proceed to scan on the opposite side.

- To test the condition of the Warble Tone Generator battery, set to the LOW INTENSITY position and listen to the sound through the Ultraprobe at 40 kHz. A continuous warbling sound should be heard. If a "beeping" is heard instead, then a full recharge of the Warble Tone Generator is indicated.

TO CHARGE THE WARBLE TONE GENERATOR:

- Plug recharger cable into recharger jack on the Warble Tone Generator and then plug the recharger into an electric outlet.
- Make sure that the LED on the charger is lit when recharging.
- The LED turns OFF when the battery is charged.

APPLICATIONS

1. LEAK DETECTION

This section will cover airborne leak detection of pressure and vacuum systems. (For information concerned with internal leaks such as in Valves and Steam Traps, refer to the appropriate sections).

What produces ultrasound in a leak? When a gas passes through a restricted orifice under pressure, it is going from a pressurized laminar flow to low pressure turbulent flow. (Fig. 1). The turbulence generates a broad spectrum of sound called "white noise". There are ultrasonic components in this white noise. Since the ultrasound will be loudest by the leak site, the detection of these signals is usually quite simple.

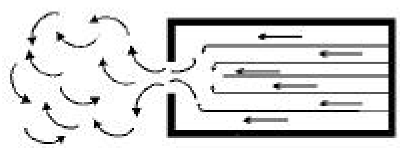


Figure 1: Pressure Leak

A leak can be in a pressurized system or in a vacuum system. In both instances, the ultrasound will be produced in the manner described above. The only difference between the two is that a vacuum leak will usually generate less ultrasonic amplitude than a pressure leak of the same flow rate. The reason for this is that the turbulence produced by a vacuum leak is occurring within the vacuum chamber while the turbulence of a pressure leak is generated in the atmosphere. (Fig.2).

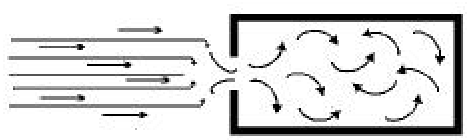


Figure 2: Vacuum Leak

What type of gas leak will be detected ultrasonically? Generally any gas, including air, will produce turbulence when it escapes through a restricted orifice. Unlike gas specific sensors, the Ultraprobe is sound specific. A gas specific sensor is limited to the particular gas it was designed to sense (e.g., helium). The Ultraprobe can sense any type of gas leak since it detects the ultrasound produced by the turbulence of a leak.

Because of its versatility, the Ultraprobe may be utilized to locate a wide variety of leaks in both pressurized and vacuum systems. This includes energy wasting compressed air leaks. Vacuum systems, turbine exhausts, vacuum chambers, material handling systems, condensers, oxygen systems can all easily be tested for leakage by listening for the turbulence of the leak.

A. HOW TO LOCATE LEAKS

1. Use the SCANNING MODULE.

2. Start off with the sensitivity at Maximum (70).

3. Begin to scan by pointing the module towards the test area. Adjust the sensitivity down if the ultrasound level is too high to tell the direction of the leak. The procedure is to go from the "gross" (highest sensitivity) to the "fine" (lower sensitivity). Make more and more subtle adjustments with the sensitivity dial to help determine the location of the leak.

4. If there is too much ultrasound in the area, reduce the sensitivity setting until you are able to determine the direction of the loudest sound and continue to scan.

5. Move closer to the test area as you scan

6. Continue to make adjustments with the sensitivity as needed in order to determine the direction of the leak sound.

7. If it is difficult to isolate the leak due to competing ultrasound, place the RUBBER FOCUSING PROBE over the scanning module and get closer to the test area.

8. Listen for a "rushing" sound while observing the meter.

9. Follow the sound to the loudest point. The meter will show a higher reading as the leak is approached.

10. In order to focus in on the leak, keep reducing the sensitivity setting and move the instrument closer to the suspected leak site until you are able to confirm a leak.

B. TO CONFIRM A LEAK:

Position the Scanning Module, or the rubber focusing probe (if it is on the scanning module) close to the suspect leak site and move it, slightly, back and forth, in all directions. If the leak is at this location, the sound will increase and decrease in intensity as you sweep over it. In some instances, it is useful to position the rubber focusing probe directly over the suspect leak site and then move up, down, left, right. If the leak is there, the sound will increase every time the scanner passes over it.

C. OVERCOMING DIFFICULTIES

1. Competing Ultrasounds
   If competing ultrasounds make it difficult to isolate a leak, there are two approaches to be taken:

   a. Manipulate the environment. This procedure is fairly straightforward. When possible, turn off the equipment that is producing the competing ultrasound or isolate the area by closing a door or window.

   b. Manipulate the instrument and use shielding techniques. If environmental manipulation is not possible, try to get as close to the test site as possible, and manipulate the instrument so that it is pointing away from the competing ultrasound. Isolate the leak area by reducing the sensitivity of the unit and by pointing the end of the rubber focusing probe up close to the test area, checking a small section at a time.

1. SHIELDING TECHNIQUES

Since ultrasound is a high frequency, short wave signal, it can usually be blocked or "shielded". NOTE: When using any method, be sure to follow your plant's or company's safety guidelines. Some common techniques are:

a. Body: place your body between the test area and the competing sounds to act as a barrier

b. Clip Board: Position the clip board close to the leak area and angle it so that it acts as a barrier between the test area and the competing sounds

c. Gloved Hand: (USE CAUTION) using a gloved hand, wrap the hand around the rubber focusing probe tip so that the index finger and the thumb are close to the very end and place the rest of the hand on the test site so that there is a complete barrier of the hand between the test area and the background noise. Move the hand and instrument together over the various test zones.

d. Wipe rag: This is the same method as the "gloved hand" method, only, in addition to the glove, use a wipe rag to wrap around the rubber focusing probe tip. Hold the rag in the gloved hand so that it acts as a "curtain", i.e., there is enough material to cover the test site without blocking the open end of the rubber focusing probe. This is usually the most effective method since it uses three barriers: the rubber focusing probe, the gloved hand and the rag.

e. Barrier: When covering a large area, it is sometimes helpful to use some reflective material, such as a welder’s curtain or a drop cloth, to act as a barrier. Place the barrier so that it acts as a "wall" between the test area and the competing sounds; sometimes the barrier is draped from ceiling to floor, at other times, it is hung over railings.

D. LOW LEVEL LEAKS

In ultrasonic inspection for leakage, the amplitude of the sound often depends upon the amount of turbulence generated at the leak site. The greater the turbulence, the louder the signal, the less the turbulence, the lower the intensity of the signal. When a leak rate is so low that it produces little, if any turbulence that is "detectable", it is considered "below threshold". If a leak appears to be of this nature:

1. Build up the pressure (if possible) to create greater turbulence.

2. Utilize LIQUID LEAK AMPLIFIER.
This patented method incorporates a UE Systems product called LIQUID LEAK AMPLIFIER, or LLA for short. LLA is a uniquely formulated liquid substance that has special chemical properties. Used as an ultrasonic "bubble test, a small amount of LLA is applied to a suspected leak site, it produces a thin film throughwhich the escaping gas will pass. When it comes in contact with a low flow of gas, it quickly forms alarge number of small "soda-like" bubbles that burst as soon as they form. This bursting effect produces an ultrasonic shock wave that is heard as a crackling sound in the headphones. In many instances the bubbles will not be seen, but they will be heard. This method is capable of obtaining successful leak checks in systems with leaks as low as $lxl0^{-6}$ ml/sec.

NOTE: The low surface tension of the LLA is the reason small bubbles form. This can be negatively changed by contamination of the leak site with another leak fluid, which can block LLA or cause large bubbles to form. If contaminated, clean the leak site with water, solvent or alcohol (check with plant regulations before selecting a decontaminating cleaning agent).

E. TONE TEST (Ultratone)

The Tone Test is an ultrasonic method for non-destructive testing which is used when it is difficult to pressurize or draw a vacuum in a system. This ultrasonic test is applicable to a wide range of items, including: CONTAINERS, TUBES, PIPES, HEAT EXCHANGERS, WELDS, GASKETS, SEALS, DOORS, WINDOWS, OR HATCHES.

The test is conducted by placing an ultrasonic transmitter, called TONE GENERATOR, inside (or on one side) of the test item. The warble pulse-signal from the TONE GENERATOR will instantly "flood" the test item and penetrate any existing leak hole. Depending on configuration and material, even thin spots in certain metals can be vibrated by the signal. By scanning for sonic penetration on the exterior surface (or opposite side) of the test item with the Ultraprobe, the leak will be detected. It will be heard as a high-pitched warble, similar to bird chirping.

The Tone Test incorporates two basic components: a TONE GENERATOR (an ultrasonic transmitter), and the Scanning Module in the Ultraprobe. To conduct the test:

1. Make certain the test item has no fluids or contaminants such as water, mud, sludge, etc., that can block the path of the transmitted ultrasound.

2. Place the Tone Generator within the container, (if it is a room, door or window to be tested, place the Tone Generator on one side pointing in the direction of the area to be tested) and close, or seal so that the Tone Generator is enclosed within.

NOTE: The size of the test area will determine the amplitude selection of the Tone Generator. If the item to be tested is small, select the LOW position. For larger items, use the HIGH position.

3. Scan the test area with the Ultraprobe as outlined in LEAK DETECTION procedure.

When positioning the Tone Generator, place the transducer facing and close to the most crucial test area. If a general area is to be checked, position the Tone Generator so that it will cover as wide an area as possible by placing it in the "middle" of the test item. How far will the sound travel? The Tone Generator is designed to cover approximately 4000 cubic feet (120 cu meters) of uninterrupted space. This is slightly larger than the size of a tractor-trailer. Placement is dependent upon such variables as the size of the leak to be tested, the thickness of the test wall and the type of material tested (i.e. is it sound absorbent or sound reflective?). Remember, you are dealing with a high frequency, short wave signal. If the sound is expected to travel through a thick wall, place the Tone Generator close to the test zone, if it is a thin metallic wall, move it farther back and use "low". For uneven surfaces it may be necessary to use two people. One person will move the Tone Generator slowly close to and around the test areas while another person scans with the Ultraprobe on the other side.

Do not use the Tone test in a complete vacuum.

Ultrasound will not travel in a vacuum. Sound waves need molecules to vibrate and conduct the signal. There are no moveable molecules in a complete vacuum.

If a partial vacuum is to be drawn where there are still some air molecules to vibrate, then the Tone Test may be implemented successfully.

In a laboratory, a form of the Tone Test is utilized in seal leaks of an electron beam microscope. The test chamber has been fitted with a specially designed transducer to emit the desired tone and a partial vacuum is created. A user then scans all seams for sonic penetration. The Tone Test has also been effectively utilized to test tanks before they are put on line, piping, refrigerator gaskets, caulking around doors and windows for air infiltration testing, heat exchangers for leaking tubes, as a Q.C. test for automobile wind noise and water leaks, on aircraft to test for problems associated with cabin pressure leaks and glove boxes for seal integrity defects.

UE SYSTEMS provides a variety of optional Warble Tone Generators. They are: 1. WTG2SP Warble Pipe Tone Generator with a 1" male threaded nipple to adapt to various pipefittings. It is used to test areas where the standard Tone Generators cannot be place such as in small pipes, sealed tanks or heat exchangers (see optional accessories, WTG-2SP).

2. UFMTG-1991 Multidirectional Tone Generator has four transducers that cover 360°. A Specially designed suction cup enables users to place the unit on a variety of surfaces, metal, plastic or glass. The UFMTG-1991 is used to detect leaks in unusual or large enclosures. Some applications include: testing bulkheads in ships, expansion joints in power plants and windshields in automobiles.

TRANSFORMERS, SWITCHGEARAND OTHER ELECTRICAL APPARATUS

2. ELECTRIC ARC, CORONA, TRACKING DETECTION

There are three basic electrical problems that are detected with the Ultraprobe 3000:

Arcing: An arc occurs when electricity is conducted to "ground". Lightning is a good example.

Corona: When voltage on an electrical conductor, such as when a high voltage transmission line exceeds the threshold value of the air around it, air begins to ionize and form a blue or purple glow.

Tracking: Often referred to as "baby arcing", it follows the path of damaged insulation.

The Ultraprobe 3000 can be used in low (below 15 kV), medium (15 kV – 115 kV) and high voltage systems (above 115 kV).

When electricity escapes in high voltage lines or when it "jumps" across a gap in an electrical connection, it disturbs the air molecules around it and generates ultrasound. Most often this sound will be perceived as a crackling or "frying" sound, in other situations it will be heard as a buzzing sound.

Typical applications include: insulators, cable, switchgear, buss bars, relays, circuit breakers, pot heads, junction boxes. In substations, components such as insulators, transformers and bushings may be tested.

Ultrasonic testing is often used in enclosed switchgear. Since ultra sound emissions can be detected by scanning around door seams and air vents, it is possible to detect serious faults such as arcing, tracking and corona without taking the switchgear off line as in an infrared scan. However, it is recommended that both tests be used with enclosed switchgear.

NOTE: **When testing electrical equipment, follow all your plant or company safety procedures. When in doubt, ask your supervisor.** ***Never touch live electrical apparatus with the Ultraprobe or its' accessories.***

The method for detecting electric arc and corona leakage is similar to the procedure outlined in leak detection. Instead of listening for a rushing sound, a user will listen for a crackling or buzzing sound. Use the scanning module of the Ultraprobe and perform a general scan of the area. The sensitivity is reduced if the signal is too strong to follow. When this occurs, reduce the sensitivity to get a mid-line reading on the meter and continue following the sound until the loudest point is located.

Determining whether a problem exists or not is relatively simple. By comparing sound quality and sound levels among similar equipment, the problem sound will tend to be quite different.

On lower voltage systems, a quick scan of bus bars often will pick up arcing or a loose connection. Checking junction boxes can reveal arcing. As with leak detection, the closer one gets to the emission site, the louder the signal.

If power lines are to be inspected and the signal does not appear to be intense enough to be detectable from the ground, use UE Systems **LRM (Long Range Module)** which will double the detection distance of the Ultraprobe and provide pinpoint detection. This is recommended for those situations in which it may be considered safer to inspect electrical apparatus at a distance. The LRM is extremely directional and will locate the exact site of an electrical discharge.

3. MONITORING BEARING WEAR

Ultrasonic inspection and monitoring of bearings is by far the most reliable method for detecting incipient bearing failure. The ultrasonic warning appears prior to a rise in temperature or an increase in low frequency vibration levels. Ultrasonic inspection of bearings is useful in recognizing all stages of bearing failure, including:

a. The beginning of fatigue failure. b. Brinelling of bearing surfaces. c. Flooding of or lack of lubricant.

In ball bearings, as the metal in the raceway, roller or ball bearing begins to fatigue, a subtle deformation begins to occur. This deforming of the metal will produce irregular surfaces, which will cause an increase in the emission of ultrasonic sound waves.

A change in amplitude from the original reading is an indication of incipient bearing failure. When a reading exceeds any previous reading by 12 dB, it can be assumed that the bearing has entered the beginning of the failure mode.

This information was originally discovered through experimentation performed by **NASA on ball bearings.** In tests performed while monitoring bearings at frequencies ranging from 24 through 50 kHz, they found that the changes in amplitude indicate incipient (the onset of bearing failure before any other indicators including heat and vibration changes. An ultrasonic system based on detection and analysis of modulations of bearing resonance frequencies can provide subtle detection capability; whereas conventional methods are incapable of detecting very slight faults. As a ball passes over a pit or fault in the race surface, it produces an impact. A structural resonance of one of the bearing components vibrates or "rings" by this repetitive impact. The sound produced is observed as an increase in amplitude in the monitored ultrasonic frequencies of the bearing.

Brinelling of bearing surfaces will produce a similar increase in amplitude due to the flattening process as the balls get out of round. These flat spots also produce a repetitive ringing that is detected as an increase in amplitude of monitored frequencies.

The ultrasonic frequencies detected by the Ultraprobe are reproduced as audible sounds. This "heterodyned" signal can greatly assist a user in determining bearing problems. When listening, it is recommended that a user become familiar with the sounds of a good bearing. A good bearing is heard as a rushing or hissing noise. Crackling or rough sounds indicate a bearing in the failure stage. In certain cases a damaged ball can be heard as a clicking sound whereas a high intensity, uniform rough sound may indicate a damaged race or uniform ball damage. Loud rushing sounds similar to the rushing sound of a good bearing only slightly rougher, can indicate lack of lubrication. Short duration increases in the sound level accompanied by a change in sound quality such as a "rough" or "scratchy" “crackling” sound will indicate a change that requires more frequent examinations and/or corrective action.

A. DETECTING BEARING FAILURE

There are two basic procedures of testing for bearing problems:

COMPARATIVE AND HISTORICAL. The comparative method involves testing two or more similar bearings and "comparing" potential differences. Historical testing requires monitoring a specific bearing over a period of time to establish its history. By analyzing bearing history, wear patterns at particular ultrasonic frequencies become obvious, which allows for early detection and correction of bearing problems.

FOR COMPARATIVE TEST

1. Use stethoscope (contact) module.

2. Select a "test spot" on the bearing housing and mark it for future; touch that spot with the contact module. In ultrasonic sensing, the more mediums or layers of material ultrasound has to travel through, the less accurate the reading will be. Therefore, be sure the contact probe is actually touching the bearing housing. If this is difficult, touch a grease fitting or touch as close to the bearing as possible.

3. Approach the bearings at the same angle, touching the same area on the bearing housing.

4. Reduce sensitivity (when needed) to hear the sound quality more clearly.

5. Listen to bearing sound through headphones to hear the "quality" of the signal for proper interpretation.

6. Select same type bearings under similar load conditions and same rotational speed.

7. Compare and note any differences in decibels and/or sound quality.

PROCEDURE FOR BEARING HISTORY (HISTORICAL):
Before starting with the HISTORICAL method for monitoring bearings, the COMPARATIVE method must be used to determine a baseline.

1. Use basic procedure as outlined above in steps 1-8.

2. Store the reading for future reference.

3. Compare this reading in Ultratrend DMS with previous (or future readings).

   a. If the decibel level has moved up 12 dB over the base line, it indicates the bearing has entered the incipient failure mode.

   b. Lack of lubrication is usually indicated by an 8 dB increase over baseline with no change in the sound quality. It is usually heard as a loud rushing sound. To avoid over lubrication, monitor the bearing as you lubricate. When the original baseline level is reached, stop lubricating. If readings do not go back to original levels or move up shortly after reaching the original levels, consider that the bearing is on the way to a failure mode and recheck frequently.

Lack of Lubrication:

To avoid lack of lubrication, note the following:

1. As the lubricant film reduces, the sound level will increase. A rise of about 8 dB over baseline accompanied by a uniform rushing sound will indicate lack of lubrication.
2. When lubricating, add just enough to return the reading to base line or stop when the sound level drops in the headphones.
3. Use caution. Some lubricants will need time to uniformly cover the bearing surfaces. Lubricate a small amount at a time.
   DO NOT OVER-LUBRICATE

Over-Lubrication:

One of the most common causes of bearing failure is over-lubrication. The excess pressure of the lubricant often breaks, or "pops" bearing seals or causes a build-up of heat, which can create stress and deformity.

To avoid over-lubrication:

1. Don't lubricate if the base line reading and base line sound quality is maintained.
2. When lubricating, use just enough lubricant to bring the ultrasonic reading to baseline.
3. As mentioned above, use caution. Some lubricants will need time to uniformly cover the bearing surfaces.

Proper Lubrication
Reduces Friction

Lack of Lubrication
Increases Amplitude Levels

SLOW SPEED BEARINGS

Monitoring slow speed bearings is possible with the Ultraprobe 3000. Due to the sensitivity range, it is quite possible to listen to the acoustic quality of bearings. In extremely slow bearings (less than 25 RPM), it is often necessary to disregard the display and listen to the sound of the bearing. In these extreme situations, the bearings are usually large (1/2" and up) and greased with high viscosity lubricant. Most often no sound will be heard as the grease will absorb most of the acoustic energy. If a sound is heard, usually a crackling sound, there is some indication of deformity occurring.

On most other slow speed bearings, it is possible to set a base line and monitor as described.

VIBRATION FFT CONNECTION

The Ultraprobe may be connected with many vibration FFT instruments via the **UE-MP-BNC-2** Miniphone to BNC connector. The Miniphone plug is inserted into the headphone jack of the Ultraprobe and the BNC connector is attached to the analog-in connector of the FFT. These connectors enable an FFT to receive the heterodyned, (translated) low frequency sound information detected from the Ultraprobe. In this instance it can be used to monitor and trend bearings, including low speed bearings. It can also extend the use of the FFT to record all types mechanical information such as leaking valves, cavitation, gear wear, etc.

3. GENERAL MECHANICAL TROUBLE SHOOTING

As operating equipment begins to fail due to component wear, breakage or misalignment, ultrasonic shifts occur. The accompanying sound pattern changes can save time and guesswork in diagnosing problems if they are adequately monitored. Therefore, an ultrasonic history of key components can prevent unplanned downtime. And just as important, if equipment should begin to fail in the field, the ULTRAPROBE can be extremely useful in trouble shooting problems.

TROUBLE SHOOTING: 1. Use the contact (stethoscope) module. 2. Touch test area(s): listen through headphones and observe the display. 3. Adjust sensitivity until mechanical operation of the equipment is heard clearly and the bar graph can fluctuate. 4. Probe equipment by touching various suspect areas. 5. If competing sounds in equipment being tested present a problem, try to "tune in" to the problem sound by probing equipment until the potential problem sound is heard. 6. To focus in on problem sounds, while probing, reduce sensitivity gradually to assist in locating the problem sound at its' loudest point. (This procedure is similar to the method outlined in LEAK LOCATION, i.e., follow the sound to its loudest point.)

MONITORING OPERATING EQUIPMENT In order to understand and keep ahead of potential problems in operating equipment, it is necessary to establish base data and observe shifts in that data. This can be accomplished by data logging readings directly into the Ultraprobe or by recording sounds to a tape recorder (by connecting to the Headphone output). These recorded sounds can be downloaded to a spectral analysis program in a computer.

PROCEDURE:

1. Select key locations to be monitored and make permanent reference marks for future testing
2. Follow steps 1-2 as outlined above in the Trouble Shooting section.
3. Store by “clicking” in the Sensitivity Dial

NOTE: In diagnosing any type of mechanical equipment, it is important to understand how that equipment operates. Being able to interpret sonic changes is dependent on a basic understanding of the operations of the particular equipment being tested. As an example, in some reciprocal compressors, the diagnosis of a valve problem in the inlet manifold is dependent on recognizing the distinctive clicking sound of a good valve vs. the muffled click of a valve in a "blow-by" mode.

In gearboxes, before missing gear teeth may be detected as an abnormal click, the normal sounds of gears must be understood. In pumps**,** certain pumps will have surges, which may confuse inexperienced operators by the constant shifting of the intensity levels. The surge pattern must be observed before a lower, consistent bar graph reading can be recognized as the true reading.

4. LOCATING FAULTY STEAM TRAPS

An ultrasonic test of steam traps is a positive test. The main advantage to ultrasonic testing is that it isolates the area being tested by eliminating confusing background noises. A user can quickly adjust to recognizing differences among various steam traps, of which there are three basic types: mechanical, thermostatic and thermodynamic. When testing steam traps ultrasonically:

1. Determine what type of trap is on the line. Be familiar with the operation of the trap. Is it intermittent or continuous drain?
2. Try to check whether the trap is in operation is it hot or cold? Use a non-contact infrared thermometer to determine this.
3. Use the contact (stethoscope) module.
4. Try to touch the contact probe towards the discharge side of the trap. Press the trigger and listen.
5. Listen for the intermittent or continuous flow operation of the trap. Intermittent traps are usually the inverted bucket, thermodynamic (disc) and thermostatic (under light loads). Continuous flow: include the float, float and thermostatic and (usually) thermostatic traps. While testing intermittent traps, listen long enough to gauge the true cycle. In some cases, this may be longer than 30 seconds. Bear in mind that the greater the load that comes to it, the longer period of time it will stay open.

In checking a trap ultrasonically, a continuous rushing sound will often be the key indicator of live steam passing through. There are subtleties for each type of trap that can be noted.

Use the sensitivity levels of the Sensitivity Selection Dial to assist your test. If a low pressure system is to be checked, adjust the sensitivity UP: if a high pressure system (above 100 psi) is to be checked, reduce the sensitivity level. (Some experimentation may be necessary to arrive at the most desirable level to be tested.) Check upstream and reduce the sensitivity to hear the trap sounds more clearly and touch downstream to compare readings.

GENERAL STEAM/CONDENSATE/FLASH STEAM CONFIRMATION

In instances where it may be difficult to determine the sound of steam, flash steam or condensate,

1. Touch at the immediate downstream side of the trap and reduce the sensitivity to hear the sounds more clearly.
2. Move 6 - 12 inches (15.2-30.5 cm) *downstream* and listen. Flashing steam will show a large drop off in intensity while leaking steam will show little drop off in intensity.

INVERTED BUCKET TRAPS normally fail in the open position because the trap loses its prime. This condition means a complete blow-through, not a partial loss. The trap will no longer operate intermittently. Aside from a continuous rushing sound, another clue for steam blow-through is the sound of the bucket clanging against the side of the trap.

A FLOAT AND THERMOSTATIC trap normally fails in the "closed" position. A pinhole leak produced in the ball float will cause the float to be weighted down or water hammer will collapse the ball float. Since the trap is totally closed - no sound will be heard. In addition, check the thermostatic element in the float and thermostatic trap. If the trap is operating correctly, this element is usually quiet; if a rushing sound is heard, this will indicate either steam or gas is blowing through the air vent. This indicates that the vent has failed in the open, position and is wasting energy.

THERMODYNAMIC (DISC) traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disc forces the disc against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disc lessens and the trap cycles. A good disc trap should cycle (hold-discharge-hold) 4-10 times per minute. When it fails, it usually fails in the open position, allowing continuous blow-through of steam.

THERMOSTATIC TRAPS (bellows & bi-metallic) operate on a difference in temperature between condensate and steam. They build up condensate so that the temperature of condensate drops down to a certain level below saturation temperature in order for the trap to open. By backing up condensate, the trap will tend to modulate open or closed depending on load.

In a bellows trap, should the bellows become compressed by water hammer, it will not function properly. The occurrence of a leak will prevent the balanced pressure action of these traps. When either condition occurs, the trap will fail in its natural position either opened or closed. If the trap falls closed, condensate will back up and no sound will be heard. If the trap falls open, a continuous rushing of live steam will be heard.

With bimetallic traps, as the bimetallic plates set due to the heat they sense and the cooling effect on the plates, they may not set properly which will prevent the plates from closing completely and allow steam to pass through. This will be heard as a constant rushing sound.

NOTE: A complimentary Steam Trap Trouble Shooting Guide is available. Visit our website, or contact UE Systems directly by phone or fax.

5. LOCATING FAULTY VALVES: Utilizing the contact (stethoscope) module in the Ultraprobe, valves can easily be monitored to determine if a valve is operating properly. As a liquid or gas flows through a pipe, there is little or no turbulence generated except at bends or obstacles. In the case of a leaking valve, the escaping liquid or gas will move from a high to a low pressure area, creating turbulence on the low pressure or "downstream" side. This produces a white noise. The ultrasonic component of this "white noise" is much stronger than the audible component. If a valve is leaking internally, the ultrasonic emissions generated at the orifice site will be heard and noted on the meter. The sounds of a leaking valve seat will vary depending upon the density of the liquid or gas. In some instances it will be heard as a subtle crackling sound, at other times as a loud rushing sound. Sound quality depends on fluid viscosity and internal pipe pressure differentials. As an example, water flowing under low to mid pressures may be easily recognized as water. However, water under high pressure rushing through a partially open valve may sound very much like steam. To discriminate:
1. Reduce the sensitivity.

A properly seated valve will generate no sound. In some high pressure situations, the ultrasound generated within the system will be so intense that surface waves will travel from other valves or parts of the system and make it difficult to diagnose valve leakage. In this case it is still possible to diagnose valve blow-through by comparing sonic intensity differences by reducing the sensitivity and touching just upstream of the valve, at the valve seat and just downstream of the valve (see "Confirming Valve Leakage In Noisy Pipe Systems).

PROCEDURE FOR VALVE CHECK

1. Use stethoscope module.
2. Touch downstream side of valve and listen through headset.
3. When necessary, if there is too much sound, reduce sensitivity.
4. For comparative readings, usually in high pressure systems:
   a. Touch upstream side and reduce sensitivity to minimize any sound.
   b. Touch valve seat and/or downstream side.
   c. Compare sonic differentials. 'If the valve is leaking, the sound level on the seat or downstream side will be equal to or louder than the upstream side.

ABCD METHOD

The ABCD method is recommended to check for the potential of competing ultrasounds downstream that may carry back to the area of inspection and give a false indication of a valve leak.

For the ABCD method,

1. Refer to steps 1-4 above.
2. Mark two equidistant points ***upstream*** (these will be point A and Point B) and compare them to two equidistant points *downstream* (point C and point D)

The sound intensity of points A and B are compared with test points C and D. If point **C** is *higher* than points A and B, the valve is considered leaking. If point **D** is *higher* than point C, this is an indication of sound being transmitted from another point *downstream*.

CONFIRMING VALVE LEAKAGE IN NOISY PIPE SYSTEMS

Occasionally in high pressure systems, stray signals occur from valves that are close by or from pipes (or conduits) feeding into a common pipe that is near the down stream side of a valve. This flow may produce false leak signals. In order to determine if the loud signal on the downstream side is coming from a valve leak or fromsome other source:

1. Move close to the suspected source (i.e., the conduit or the other valve).

2. Touch at the upstream side of the suspected source.

3. Reduce sensitivity until the sounds are clearer.

4. Touch at short intervals (such as every 6 - 12 inches (15-30.5 cm) and note the meter changes.

5. If the sound level decreases as you move towards the test valve, it indicates that the valve is not leaking.

6. If the sound level increases as you approach the test valve, it is an indication of a leak in the valve.

MISCELLANEOUS PROBLEM AREAS

A. UNDERGROUND LEAKS

Underground leak detection depends upon the amount of ultrasound generated by the particular leak. Some slow leaks will emit very little ultrasound. Compounding the problem is the fact that earth will tend to insulate ultrasound. In addition, loose soil will absorb more ultrasound than firm soil. If the leak is close to the surface and is gross in nature, it will be quickly detected. The more subtle leaks can also be detected but with some additional effort. In some instances it will be necessary to build up pressure in the line to generate greater flow and more ultrasound. In other cases it will be necessary to drain the pipe area in question, isolate the area by valving it off and inject a gas (air or nitrogen) to generate ultrasound through the leak site. This latter method has proven very successful. It is also possible to inject a test gas into the test area of the pipe without draining it. As the pressurized gas moves through the liquid into the leak site, it produces a crackling sound, which may be detected.

PROCEDURE:
1. Use contact (stethoscope) module.
2. Touch surfaces over ground - ***DO NOT JAM*** probe to ground. Jamming can cause probe damage.

In some instances it will be necessary to get close to the "source" of the leak. In this situation, use a thin, sturdy metal rod and drive it down close to, but not touching, the pipe. Touch the contact probe to the metal rod and listen for the leak sound. This should be repeated approximately every 1-3 feet until the leak sound is heard.

To locate the leak area, gradually position the rod until the leak sound is heard at its loudest point. An alternative to this is to use a flat *metal disc or coin* and drop it on the test area. Touch the disc and listen at 20 kHz. This is useful when testing concrete or asphalt to eliminate scratching sounds caused by slight movements of the stethoscope module on these surfaces.

LEAKAGE BEHIND WALLS

1. Look for water or steam markings such as discoloration, spots in wall or ceiling, etc.
2. If steam, feel for warm spots in wall or ceiling or use a non-contact infrared thermometer.
3. Listen for leak sounds. The louder the signal the closer you are to the leak site.

PARTIAL BLOCKAGE:

When partial blockage exists, a condition similar to that of a bypassing valve is produced. The partial blockage will generate ultrasonic signals (often produced by turbulence just down stream). If a partial blockage is suspected, a section of piping should be inspected at various intervals. The ultrasound generated within the piping will be greatest at the site of the partial blockage.

PROCEDURE:

1. Use stethoscope module.
2. Touch downstream side of suspected area and listen through headset.
3. When necessary, if there is too much sound, reduce sensitivity.
4. Listen for an increase in ultrasound created by the turbulence of partial blockage.

FLOW DIRECTION

Flow in piping increases In intensity as it passes through a restriction or a bend in the piping. As flow travels upstream, there is an increase in turbulence and therefore the intensity of the ultrasonic element of that turbulence at the flow restriction. In testing flow direction, the ultrasonic levels will have greater intensity in the DOWNSTREAM side than in the UPSTREAM side.

PROCEDURE:

1. Use stethoscope mode.
2. Begin test at maximum sensitivity level.
3. Locate a bend in the pipe system (preferably 60 degrees or more).
4. Touch one side of bend and note dB reading.
5. Touch other side of bend and note dB reading.
6. The side with the higher (louder) reading should be the downstream side.

NOTE: Should it be difficult to observe a sound differential, reduce sensitivity and test as described until a sonic difference is recognized.

ULTRASOUND TECHNOLOGY The technology of ultrasound is concerned with sound waves that occur above human perception. The average threshold of human perception is 16,500 Hertz. Although the highest sounds some humans are capable of hearing is 21,000 Hertz, ultrasound technology is usually concerned with frequencies from 20,000 Hertz and up. Another way of stating 20,000 Hertz is 20 kHz, (KILOHERTZ). One kilohertz is 1,000 Hertz.

Since ultrasound is a high frequency, it is a short wave signal. Its' properties are different from audible or low frequency sounds. A low frequency sound requires less acoustic energy to travel the same distance as high frequency sound.

The ultrasound technology utilized by the Ultraprobe is generally referred to as Airborne ultrasound. Airborne ultrasound is concerned with the transmission and reception of ultrasound **through the atmosphere without the** need of sound conductive (interface) gels. It can and does incorporate methods of receiving signals generated through one or more media via wave guides.

There are ultrasonic components in practically all forms of friction. As an example, if you were to rub your thumb and forefinger together, you will generate a signal in the ultrasonic range. Although you might be able to very faintly hear the audible tones of this friction, with the Ultraprobe it will sound extremely loud.

The reason for the loudness is that the Ultraprobe converts the ultrasonic signal into an audible range and then amplifies it. Due to the comparative low amplitude nature of ultrasound, amplification is a very important feature.

Although there are obvious audible sounds emitted by most operating equipment, it is the ultrasonic elements of the acoustic emissions that are generally the most important. For preventative maintenance, many times an individual will listen to a bearing through some simple type of audio pick-up to determine bearing wear. Since that individual is hearing ONLY the audio elements of the signal, the results of that type of diagnosis will be quite gross. The subtleties of change within the ultrasonic range will not be perceived and therefore omitted. When a bearing is perceived as being bad in the audio range it is in need of immediate replacement. Ultrasound offers a predictable diagnostic capacity. When changes begin to occur in the ultrasonic range, there is still time to plan appropriate maintenance. In the area of leak detection, ultrasound offers a fast, accurate method of locating minute as well as gross leaks. Since ultrasound is a short wave signal, the ultrasonic elements of a leak will be loudest and most clearly perceived at the leak site. In loud factory type environments, this aspect of ultrasound makes it even more useful.

Most ambient sounds in a factory will block out the low frequency elements of a leak and thereby render audible leak inspection useless. Since the Ultraprobe is not capable of responding to low frequency sounds, it will hear only the ultrasonic elements of a leak. By scanning the test area, a user may quickly spot a leak.

Electrical discharges such as arcing, tracking and corona have strong ultrasonic components that may be readily detected. As with generic leak detection, these potential problems can be detected in noisy plant environments with the Ultraprobe.

14 Hayes Street
Elmsford, NY 10523 USA

Tel: 914-592-1220
Fax: 347-2181
Email: info@uesystems.com
Web page: http://www.uesystems.com